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Bird Community Monitoring at Pipestone National Monument, Minnesota

2009 Status Report

Natural Resource Data Series NPS/HTLN/NRDS—2010/045

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Introduction

Birds are an important component of park ecosystems, as their high body temperature, rapid metabolism, and high ecological position in most food webs make them good indicators of the effects of local and regional changes in ecosystems. It has been suggested that management activities aimed at preserving habitat for bird populations, such as for neotropical migrants, can have the added benefit of preserving entire ecosystems and their attendant ecosystem services (Karr 1991, Maurer 1993). Moreover, birds have a tremendous following among the public and many parks provide information on the status and trends of birds through their interpretive programs.

We use trends in the composition and abundance of bird populations as long-term indicators of ecosystem integrity in the grassland habitat of Pipestone National Monument, Minnesota (PIPE). Ecosystem integrity is defined as the system's capability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region (Karr and Dudley 1981). Research has demonstrated that birds serve as good indicators of changes in ecosystems (Cairns et al. 2004, Mallory et al. 2006, Wood et al. 2006).

Therefore, changes in the numbers and composition of bird communities in the grassland areas may reflect the effectiveness of management in restoring and maintaining these communities at PIPE. Long-term trends in community composition and abundance of breeding bird populations provide one measure for assessing the ecological integrity and sustainability of these systems.

Methods

Site Selection for Bird Plots

Permanent monitoring locations or 'plots' were selected by overlaying a systematic grid of 100 x 100 meter cells (originating from a random start point). The orientation of the grid was rotated 45 degrees to prevent monitoring sites from being influenced by man-made features (roads, fences, etc.) located along cardinal directions. Areas with sensitive cultural or natural resources were excluded from sampling. We established 68 permanent plots on PIPE (Fig. 1).

During bird surveys, monitoring plots were located using navigation waypoints (Appendix 1) in a GPS unit and temporarily marked with 36-inch pin flags to aid in re-locating the plots for habitat assessment, eliminating the need for permanent plot markers. We collected pin flags from each plot once the habitat work was completed. Monitoring plots will be re-located each year we conduct a bird survey.

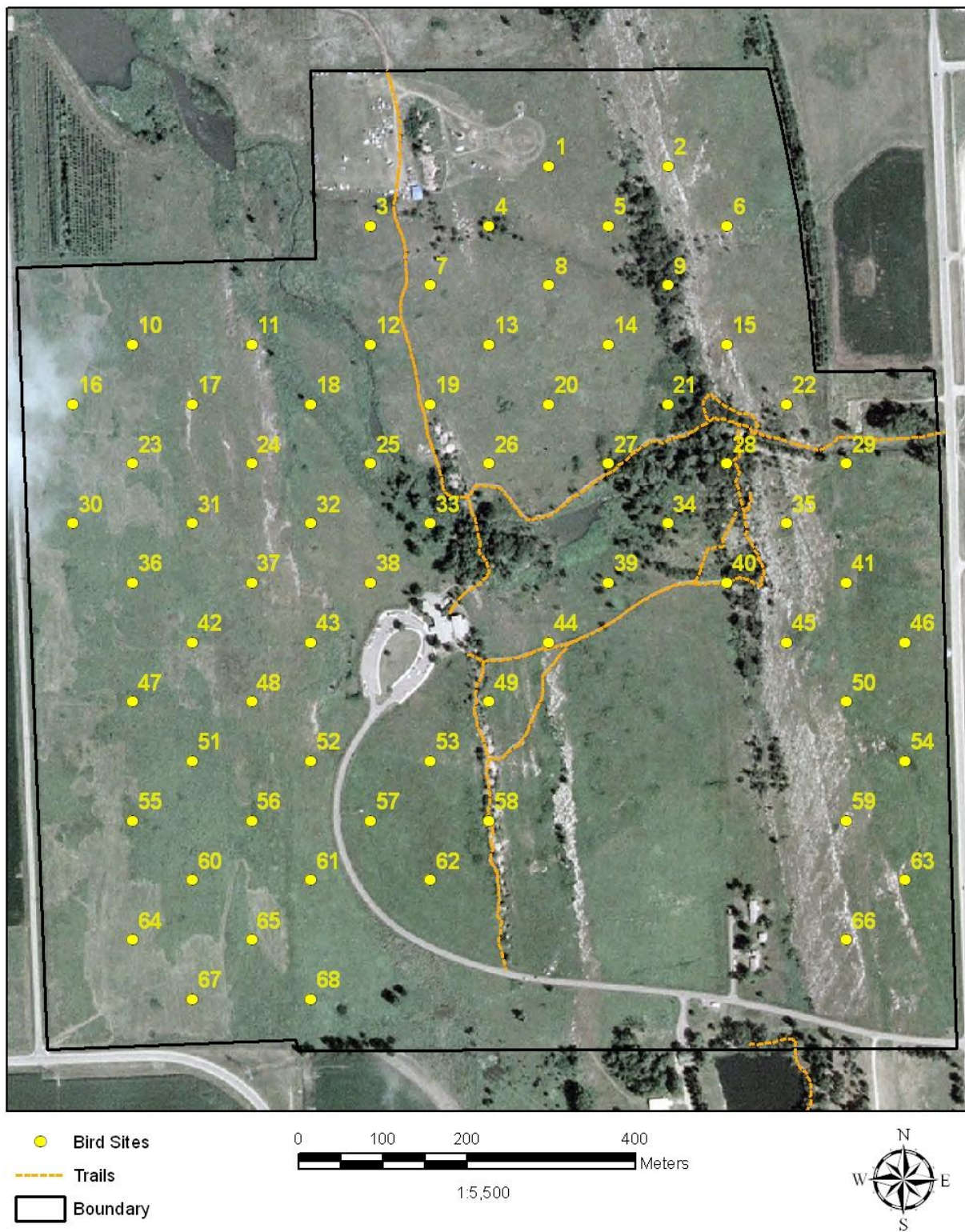


Figure 1. Bird plot locations on Pipestone National Monument, Minnesota.

Bird Surveys

Bird surveys followed methods outlined in the bird monitoring protocol by Peitz et al. (2008) and summarized below. Variable circular plot counts, a point count methodology that incorporates a measure of detectability into population estimates, were used to survey birds present (Fancy 1997). All birds seen or heard at plots during 5-min sampling periods were counted along with their corresponding distance from observer. Bird observations were separated into two time segments: those detected during the first three minutes of the count (to allow future comparisons with the national Breeding Bird Survey data), and any new birds detected during the final two minutes of the count. For most species, we recorded each individual bird as a separate observation. For species that usually occur in clusters or flocks, the units recorded were cluster or flock size, and not the individual bird. During analysis, each individual in a cluster or flock were treated as separate observations. After completing a count at a plot and filling out the data sheet, the observer navigated to the next plot using a GPS unit. While traveling between plots, the observer was vigilant for the presence of species not recorded during timed surveys. These species help formulate a more complete species list for the park by identifying species missed during timed surveys. We sampled birds during a period when it was light enough to observe birds to four hours after sunrise. A total of 68 plots were sampled in 2009.

Variable circular plot counts were conducted in an attempt to get an “instantaneous count” of all birds present. The observer recorded birds flushed from a plot when approached and the counts were started as soon as the observer reached plot center. An important assumption of the method is that birds exactly at the center of the plot have a 100% probability of being detected, and that there is a high probability of detecting birds within the first 5-10 meters of the plot center. The most important birds to detect are those very close to the observer (within the first 5-10 meters), and it is highly desirable that estimated distances, or those taken with a rangefinder, be within 1-2 meters of actual distances for any bird within 20 meters of the observer. However, we recorded all birds seen or heard along with distance from the observer when possible. For this report, all birds seen or heard during the full 5-min are included.

Bird Habitat

The collection of habitat data followed methods outlined in the bird monitoring protocol by Peitz et al. (2008). A summary of the sampling method's follows: Habitat data collection started after the first variable circular plot count was completed. Observers visited plots for habitat measures in the same order they were surveyed for birds to avoid disturbing birds on a plot prior to the survey. Once the habitat crew arrived at a plot, they set up the center subplot and completed all habitat measures for this subplot and the 50-m radius plot.

We characterized habitat available for each bird species on a number of different scales. Slope, slope variability, aspect, aspect variability, and topographic position of each 50-m radius plot were determined and recorded first. Measurements were recorded during this first year of monitoring, and will not be re-measured in subsequent years. The amount of various vegetation types and the amount of road and water cover on each plot sampled were recorded. As plots were sampled, horizontal vegetation cover was estimated on subplots in 0.25-m intervals from 0.0 to 2.0 meters above ground surface using a 0.15-m wide cover board. Area of the cover board obscured by vegetation was estimated at 15-m distances from plot center. Using a graduated measuring rod, vertical vegetation structure was measured in 1-m increments up to 7.5 meters in

height at four locations around the perimeter of the subplot. Locations were in the four cardinal directions. Vertical structure was recorded for deciduous and herbaceous vegetation. Trees were tallied by species and size class (<1.0 cm, 1.1 – 2.5 cm, 2.6 – 8.0 cm, 8.1 – 15.0 cm, 15.1 – 23.0 cm, 23.1 – 38.0 or >38.0 cm) on the subplot. Lastly, at the subplot, ground and foliar cover were recorded in a 1.78-m radius nested sample plot. Ground cover included deciduous and grass litter, bare soil, rock, woody debris (>2.5 cm diameter), and unvegetated. Foliar cover was estimated for six plant guilds, including warm- and cool-season grasses, forbs, moss and lichens, shrubs and vines, tree seedlings, and total foliar cover (<1.5 m tall). Average parameter values were reported for the monument.

Data Analysis

Prior to summary analysis, the residency status (permanent resident, summer resident, migrant, and winter resident) of each bird species recorded was determined. Identifying the residency of each species helps to exclude migrants and winter residents from analysis of breeding birds within PIPE. Hereafter, permanent and summer resident birds are referred to as breeding species. The frequency and abundance of breeding bird species were determined two ways. First, for each breeding species, the number of individuals encountered per plot visit within a habitat was determined (individuals / plot visit). And second, the proportion of plots occupied by each breeding species within each habitat was determined (total number of plots occupied by a species / total number of plots visited).

Location and permanent abiotic measures on each plot and habitat subplot were determined. Averages (\pm std dev) for semi-permanent plot data, including road and water cover were calculated from plot estimates. Using plot values, averages (\pm std dev) for horizontal vegetation cover between 0 – 0.25, 0.25-0.5, 0.5 – 0.75, 0.75-1.0, 1.0 – 1.25, 1.25-1.5, 1.5 – 1.75, and 1.75 – 2.0 meters were calculated. Average (\pm std dev) vertical structure diversity was estimated and reported as well.

$$\text{Structural Diversity Index} = \frac{((\sum p_i / 8) + a) * 100}{2}$$

Where p_i – is the observed frequency for vegetation in the i th interval touching a measuring rod out of eight measuring events, and a – is the percent of intervals with recorded vegetation in eight height increments. Vertical structure diversity values are weighted equally to represent both the vertical height of vegetation and how dense the vegetation is within each height increment.

Within each plot, ground cover, including deciduous and grass litter, bare soil, rock, woody debris (>2.5 cm DBH), and unvegetated were averaged (\pm std dev) across plots. Foliar cover, by guild of warm- and cool-season grasses, forbs, mosses and lichens, shrubs and vines, tree seedlings and total foliar cover (<1.5 m tall) were averaged (\pm std dev) across plots as well. Also reported is species composition and size classes of trees.

Results

Bird Surveys

Forty avian species were recorded on PIPE between May 14 and 16, 2009 (Table 1). Thirty-six of the 40 species are year round or summer residents. Three species, Double-crested cormorant (*Phalacrocorax auritus*), Yellow-rumped warbler (*Dendroica coronate*), and White-crowned sparrow (*Zonotrichia leucophrys*) are migrants through the area. The Lapland longspur (*Calcarius lapponicus*) is a winter resident on the monument. Eight species--Bobolink (*Dolichonyx oryzivorus*), Dickcissel (*Spiza americana*), Eastern meadowlark (*Sturnella magna*), Grasshopper sparrow (*Ammodramus savannarum*), Northern harrier (*Circus cyaneus*), Sedge wren (*Cistothorus platensis*), Upland sandpiper (*Bartramia longicauda*), and Western meadowlark (*Sturnella neglecta*)--are grassland obligate species. The Brown thrasher (*Toxostoma rufum*), Dickcissel, and Grasshopper sparrow are breeding species of continental importance. Common grackle (*Quiscalus quiscula*) and Bobolink were the most commonly encountered and widely distributed species on the monument in 2009 (Table 2).

Table 1. Species recorded at Pipestone National Monument, Minnesota during breeding bird surveys in 2009.

| Common name | Species name | AOU code | Residency Status ¹ |
|-----------------------------|-------------------------------------|-------------|-------------------------------|
| American crow | <i>Corvus brachyrhynchos</i> | AMCR | R |
| American goldfinch | <i>Carduelis tristis</i> | AMGO | R |
| American robin | <i>Turdus migratorius</i> | AMRO | SR |
| Bank swallow | <i>Riparia riparia</i> | BANS | SR |
| Barn swallow | <i>Hirundo rustica</i> | BARS | SR |
| Belted kingfisher | <i>Ceryle alcyon</i> | BEKI | R |
| Brown-headed cowbird | <i>Molothrus ater</i> | BHCO | SR |
| Bobolink* | <i>Dolichonyx oryzivorus</i> | BOBO | SR |
| Brown thrasher | <i>Toxostoma rufum</i> | BRTH | SR |
| Canada goose | <i>Branta Canadensis</i> | CAGO | SR |
| Clay-colored sparrow | <i>Spizella pallida</i> | CCSP | SR |
| Cedar waxwings | <i>Bombycilla cedrorum</i> | CEDW | R |
| Common grackle | <i>Quiscalus quiscula</i> | COGR | SR |
| Common yellowthroat | <i>Geothlypis trichas</i> | COYE | SR |
| Double-crested cormorant | <i>Phalacrocorax auritus</i> | DCCO | M |
| Dickcissel* | <i>Spiza americana</i> | DICK | SR |
| Eastern kingbird | <i>Tyrannus tyrannus</i> | EAKI | SR |
| Eastern meadowlark* | <i>Sturnella magna</i> | EAME | SR |
| Field sparrow | <i>Spizella pusilla</i> | FISP | SR |
| Great blue heron | <i>Ardea Herodias</i> | GBHE | SR |
| Gray catbird | <i>Dumetella carolinensis</i> | GRCA | SR |
| Grasshopper sparrow* | <i>Ammodramus savannarum</i> | GRSP | SR |
| House wren | <i>Troglodytes aedon</i> | HOWR | SR |
| Killdeer | <i>Charadrius vociferus</i> | KILL | SR |
| Lapland longspur | <i>Calcarius lapponicus</i> | LALO | WR |
| Mallard | <i>Anas platyrhynchos</i> | MALL | R |

Table 1. Species recorded at Pipestone National Monument, Minnesota during breeding bird surveys in 2009 (continued).

| Common name | Species name | AOU code | Residency Status ¹ |
|-------------------------------|-----------------------------------|----------|-------------------------------|
| Mourning dove | <i>Zenaida macroura</i> | MODO | R |
| Yellow-rumped warbler | <i>Dendroica coronata</i> | MYWA | M |
| Northern harrier* | <i>Circus cyaneus</i> | NOHA | R |
| Northern rough-winged swallow | <i>Stelgidopteryx serripennis</i> | NRWS | SR |
| Northern shoveler | <i>Anas clypeata</i> | NSHO | SR |
| Ring-necked pheasant | <i>Phasianus colchicus</i> | RNPH | R |
| Red-winged blackbird | <i>Agelaius phoeniceus</i> | RWBL | R |
| Sedge wren* | <i>Cistothorus platensis</i> | SEWR | SR |
| Song sparrow | <i>Melospiza melodia</i> | SOSP | R |
| Tree swallow | <i>Tachycineta bicolor</i> | TRES | SR |
| Upland sandpiper* | <i>Bartramia longicauda</i> | UPSA | SR |
| White-crowned sparrow | <i>Zonotrichia leucophrys</i> | WCSP | M |
| Western meadowlark* | <i>Sturnella neglecta</i> | WEME | SR |
| Yellow warbler | <i>Dendroica petechia</i> | YWAR | SR |

* Obligate grassland species. These species require relatively treeless grasslands for all or most of their breeding cycle (Northern Prairie Wildlife Research Center. Accessed in 2009, <http://www.npwrc.usgs.gov/>).

¹ Residency status: SR = summer resident; R = year around resident; M = late season migrant; WR = winter resident (Stokes and Stokes 1996).

Species names are valid and verified names obtained from ITIS. (Integrated Taxonomic Information System. Accessed in 2009, <http://www.itis.gov/>).

Bolded species names are those species considered of continental importance (Rich et al. 2004).

Table 2. Number of individuals encountered per plot visit, and proportion of plots occupied out of 68 for breeding bird species recorded at Pipestone National Monument, Minnesota during the 2009 breeding bird surveys. Number of individuals per plot, and proportion of plots occupied includes all individuals recorded on plots during a 5-min survey, including flyovers.

| Common name | Individuals / plot visit | Proportion of plots occupied |
|-------------------------------|--------------------------|------------------------------|
| American crow | 0.06 | 0.04 |
| American goldfinch | 0.40 | 0.24 |
| American robin | 0.50 | 0.30 |
| Bank swallow | 0.06 | 0.04 |
| Barn swallow | 0.03 | 0.03 |
| Belted kingfisher | 0.01 | 0.01 |
| Brown-headed cowbird | 0.44 | 0.26 |
| Bobolink | 0.85 | 0.44 |
| Brown thrasher | 0.07 | 0.06 |
| Canada goose | 0.41 | 0.18 |
| Clay-colored sparrow | 0.21 | 0.18 |
| Cedar waxwings | 0.37 | 0.01 |
| Common grackle | 1.18 | 0.49 |
| Common yellowthroat | 0.01 | 0.01 |
| Dickcissel | 0.03 | 0.03 |
| Eastern kingbird | 0.03 | 0.03 |
| Eastern meadowlark | 0.01 | 0.01 |
| Field sparrow | 0.22 | 0.15 |
| Great blue heron | 0.01 | 0.01 |
| Gray catbird | 0.03 | 0.03 |
| Grasshopper sparrow | 0.18 | 0.18 |
| House wren | 0.03 | 0.03 |
| Killdeer | 0.03 | 0.03 |
| Mallard | 0.06 | 0.03 |
| Mourning dove | 0.12 | 0.09 |
| Northern harrier | 0.01 | 0.01 |
| Northern rough-winged swallow | 0.10 | 0.06 |
| Northern shoveler | 0.07 | 0.06 |
| Ring-necked pheasant | 0.32 | 0.25 |
| Red-winged blackbird | 0.41 | 0.22 |
| Sedge wren | 0.04 | 0.03 |
| Song sparrow | 0.01 | 0.01 |
| Tree swallow | 0.21 | 0.09 |
| Upland sandpiper | 0.01 | 0.01 |
| Western meadowlark | 0.04 | 0.04 |
| Yellow warbler | 0.03 | 0.01 |

Bird Habitat

Abiotic features of plots sampled for breeding birds and habitat composition are given in Table 3. The variability of slope and aspect measurements is low to medium for plots on the monument. The slopes of all plots on the monument were ≤ 12 degrees.

Habitats on the plots consist primarily of the field / prairie type, with much lesser amounts of other types present (Table 4). Canopy cover averaged $\sim 7\%$, with cover provided by hardwood trees. Basal area from hardwood trees averaged $0.6 \text{ m}^2 / \text{ha}$ on plots. Hardwood tree species from seven different families contributed to the canopy cover and basal area (Table 5).

The densest vegetation occurred in the profile class 0.25 meters when read from a 15-m distance (Table 4). However, vegetation cover was recorded in all height classes. Average vertical structure diversity estimate is $\sim 10\%$.

Grass litter was the dominant litter type recorded (Table 4). Plots were primarily unvegetated at the ground level. Cool-season grass and forbs dominated the forage guilds during our mid-May bird surveys. Total foliar coverage averaged over $\sim 46\%$ across plots. Prescribed fire, implemented shortly before the bird surveys in all likelihood reduced the amount of grass litter and foliar cover present on plots.

Table 3. Abiotic features of 50-m radius plots sampled for breeding birds at Pipestone National Monument, Minnesota.

| Plot number | Slope ($^{\circ}$) | Slope variability | Aspect ($^{\circ}$) | Aspect variability | Topographic position | Habitat type |
|--------------|-------------------------|----------------------|--------------------------|-----------------------|-------------------------|-----------------|
| PIPETweety1 | 2.0 | Low | 268 | Low | Mid-slope | Grassland |
| PIPETweety2 | 2.0 | Low | 256 | Low | Upper-slope | Grassland |
| PIPETweety3 | 3.0 | Medium | 261 | Medium | Lower-slope | Grassland |
| PIPETweety4 | 3.0 | Low | 170 | Low | Mid-slope | Grassland |
| PIPETweety5 | 2.0 | Low | 248 | Low | Mid-slope | Grassland |
| PIPETweety6 | 3.0 | Medium | 194 | Medium | Upper-slope | Grassland |
| PIPETweety7 | 4.0 | Low | 257 | Low | Mid-slope | Grassland |
| PIPETweety8 | 1.0 | Low | 266 | Low | Lower-slope | Grassland |
| PIPETweety9 | 12.0 | High | 282 | High | Ledge | Grassland |
| PIPETweety10 | 1.0 | Low | 33 | Low | Mid-slope | Grassland |
| PIPETweety11 | 3.0 | Medium | 208 | Medium | Level | Grassland |
| PIPETweety12 | 1.0 | Low | 324 | Low | Escarpment / face | Grassland |
| PIPETweety13 | 5.0 | Low | 263 | Low | | Grassland |
| PIPETweety14 | 3.0 | Low | 274 | Low | Mid-slope | Grassland |
| PIPETweety15 | 2.0 | Low | 258 | Low | Level | Grassland |
| PIPETweety16 | 3.0 | Low | 19 | Low | Upper-slope | Grassland |
| PIPETweety17 | 3.0 | Low | 14 | Low | Mid-slope | Grassland |
| PIPETweety18 | 3.0 | Medium | 332 | Medium | Level | Grassland |
| PIPETweety19 | 6.0 | Low | 244 | Low | Lower-slope | Grassland |
| PIPETweety20 | 1.0 | Low | 234 | Low | Mid-slope | Grassland |
| PIPETweety21 | 2.0 | Low | 219 | Low | Lower-slope | Grassland |
| PIPETweety22 | 1.0 | High | 217 | High | Draw | Grassland |
| PIPETweety23 | 3.0 | Low | 34 | Low | Upper-slope | Grassland |
| PIPETweety24 | 1.0 | Medium | 57 | Low | Lower-slope | Grassland |
| PIPETweety25 | 2.0 | Medium | 349 | Medium | Level | Grassland |
| PIPETweety26 | 1.0 | Low | 203 | Low | Level | Grassland |
| PIPETweety27 | 2.0 | Low | 198 | Low | Lower-slope | Grassland |

Table 3. Abiotic features of 50-m radius plots sampled for breeding birds at Pipestone National Monument, Minnesota (continued).

| Plot number | Slope (°) | Slope variability | Aspect (°) | Aspect variability | Topographic position | Habitat type |
|--------------|-----------|-------------------|------------|--------------------|----------------------|--------------|
| PIPETweety28 | 11.0 | Medium | 260 | Medium | Escarpment / face | Grassland |
| PIPETweety29 | 3.0 | Low | 1 | Low | Level | Grassland |
| PIPETweety30 | 2.0 | Low | 210 | Low | Upper-slope | Grassland |
| PIPETweety31 | 2.0 | Low | 56 | Low | Lower-slope | Grassland |
| PIPETweety32 | 3.0 | Low | 306 | Low | Level | Grassland |
| PIPETweety33 | 2.0 | Low | 238 | Low | Level | Grassland |
| PIPETweety34 | 3.0 | Low | 299 | Low | Crest | Grassland |
| PIPETweety35 | 1.0 | Low | 290 | Low | Lower-slope | Grassland |
| PIPETweety36 | 1.0 | Low | 82 | Low | Upper-slope | Grassland |
| PIPETweety37 | 1.0 | Low | 30 | Low | Level | Grassland |
| PIPETweety38 | 0.0 | Low | 4 | Low | Level | Grassland |
| PIPETweety39 | 3.0 | Low | 317 | Low | Lower-slope | Grassland |
| PIPETweety40 | 3.0 | Medium | 269 | Medium | Escarpment / face | Grassland |
| PIPETweety41 | 2.0 | Medium | 302 | Medium | Upper-slope | Grassland |
| PIPETweety42 | 3.0 | Low | 42 | Low | Lower-slope | Grassland |
| PIPETweety43 | 1.0 | Low | 63 | Low | Lower-slope | Grassland |
| PIPETweety44 | 2.0 | Low | 284 | Low | Level | Grassland |
| PIPETweety45 | 4.0 | Low | 264 | Low | Level | Grassland |
| PIPETweety46 | 2.0 | Low | 19 | Low | Level | Grassland |
| PIPETweety47 | 3.0 | Low | 33 | Low | Mid-slope | Grassland |
| PIPETweety48 | 2.0 | Low | 65 | Low | Mid-slope | Grassland |
| PIPETweety49 | 3.0 | High | 197 | Medium | Ledge | Grassland |
| PIPETweety50 | 3.0 | Low | 230 | Low | Upper-slope | Grassland |
| PIPETweety51 | 1.0 | Low | 101 | Low | Mid-slope | Grassland |
| PIPETweety52 | 2.0 | Low | 70 | Low | Lower-slope | Grassland |
| PIPETweety53 | 1.0 | Medium | 238 | Medium | Level | Grassland |
| PIPETweety54 | 2.0 | Low | 12 | Low | Level | Grassland |
| PIPETweety55 | 1.0 | Low | 93 | Low | Upper-slope | Grassland |
| PIPETweety56 | 2.0 | Low | 77 | Low | Mid-slope | Grassland |
| PIPETweety57 | 2.0 | Low | 100 | Low | Level | Grassland |
| PIPETweety58 | 12.0 | Medium | 267 | Medium | Ledge | Grassland |
| PIPETweety59 | 2.0 | Low | 275 | Low | Upper-slope | Grassland |
| PIPETweety60 | 3.0 | Low | 83 | Low | Mid-slope | Grassland |
| PIPETweety61 | 2.0 | Low | 82 | Low | Mid-slope | Grassland |
| PIPETweety62 | 2.0 | Low | 209 | Low | Level | Grassland |
| PIPETweety63 | 2.0 | Medium | 342 | Medium | Depression | Grassland |
| PIPETweety64 | 3.0 | Low | 101 | Low | Upper-slope | Grassland |
| PIPETweety65 | 1.0 | Low | 86 | Low | Mid-slope | Grassland |
| PIPETweety66 | 2.0 | Low | 261 | Low | Upper-slope | Grassland |
| PIPETweety67 | 2.0 | Low | 84 | Low | Mid-slope | Grassland |
| PIPETweety68 | 1.0 | Low | 93 | Low | Lower-slope | Grassland |

Table 4. Averages (\pm std dev) for habitat parameters measured on 68 plots at Pipestone National Monument, Minnesota during the 2009 bird breeding season. Within the scale in which habitat parameters are collected, 50-m plot, 5-m subplot, and 1.78-m sample plot, percentages of coverage may not necessarily sum to 100% as values are averaged over mid-point values of cover classes (i.e. class 1 = 0.5%, class 2 = 3.0%, class 3 = 15.0%, class 4 = 37.5%, class 5 = 62.5%, class 6 = 85.0%, and class 7 = 97.5%).

| Habitat Parameter | Averages (\pm std dev) |
|----------------------------------|-------------------------------|
| | 50 meter plot |
| Cornfield (%) | 0.13 (0.62) |
| Field / Prairie (%) | 72.21 (36.97) |
| Floodplain (%) | 4.67 (19.76) |
| Lawn (%) | 1.57 (10.44) |
| Parking Lot (%) | 0.22 (1.82) |
| Paved Road (%) | 1.95 (4.85) |
| Pond (%) | 0.31 (1.88) |
| Restored Prairie (%) | 9.96 (28.56) |
| Riparian Prairie (%) | 0.99 (5.17) |
| Riparian Woodland (%) | 0.55 (4.55) |
| River Terrace (%) | 0.22 (1.82) |
| Service Road (%) | 0.01 (0.06) |
| Shrub (%) | 1.51 (8.78) |
| Stream (%) | 1.30 (5.44) |
| Trail (%) | 0.76 (3.12) |
| Wetland (%) | 0.22 (1.82) |
| Woodland (%) | 6.34 (15.83) |
| | 5 meter subplot |
| Canopy Cover | |
| Hardwood (%) | 7.25 (23.18) |
| Canopy Height | |
| Hardwood (m) | 1.37 (3.49) |
| Basal Area | |
| Hardwood (m ² / ha) | 0.60 (2.12) |
| Vegetation Profile | |
| 0.00 – 0.25 m (%) | 82.07 (28.80) |
| 0.25 – 0.50 m (%) | 49.10 (39.61) |
| 0.50 – 0.75 m (%) | 7.33 (15.56) |
| 0.75 – 1.00 m (%) | 4.02 (13.50) |
| 1.00 – 1.25 m (%) | 2.66 (12.76) |
| 1.25 – 1.50 m (%) | 2.43 (13.94) |
| 1.50 – 1.75 m (%) | 2.71 (15.56) |
| 1.75 – 2.00 m (%) | 3.79 (18.10) |
| Vertical structure diversity (%) | 9.52 (6.49) |
| | 1.78 meter sample plot |
| Deciduous litter (%) | 3.30 (6.48) |
| Grass litter (%) | 44.23 (27.26) |
| Bare soil (%) | 5.54 (8.53) |
| Rock (%) | 9.96 (21.96) |
| Woody debris (%) | 2.34 (4.77) |
| Unvegetated (%) | 87.72 (8.60) |
| Cool-season grass (%) | 39.68 (28.51) |
| Forb (%) | 7.90 (8.87) |
| Moss and lichen (%) | 1.61 (5.42) |
| Woody shrub and vine (%) | 4.03 (8.67) |
| Tree seedling (%) | 0.01 (0.06) |
| Total foliar (%) | 46.12 (28.22) |

Table 5. Stems per hectare of trees found on Pipestone National Monument, Minnesota by size class, during the 2009 bird breeding season. Stems per hectare of trees are reported by family.

| Family | <1.0 cm | 1.1 – 2.5 cm | 2.6 – 8.0 cm | 8.1 – 15.0 cm | 15.1 – 23.0 cm | 23.1 – 38.0 cm | >38.0 cm |
|--------------------|--------------|-----------------|-----------------|------------------|-------------------|-------------------|-------------|
| Aceraceae | -- | -- | -- | -- | 24.34 | -- | -- |
| Rosaceae | -- | -- | 3.74 | -- | -- | -- | -- |
| Oleaceae | -- | -- | -- | -- | 1.87 | -- | -- |
| Rosaceae | 129.19 | -- | -- | -- | -- | -- | -- |
| Fagaceae | -- | -- | -- | -- | 22.47 | -- | -- |
| Rhamnaceae | 3.74 | -- | -- | -- | -- | -- | -- |
| Ulmaceae | 1.87 | -- | -- | -- | -- | -- | -- |
| Total Stems | 134.8 | -- | 3.74 | -- | 48.68 | -- | -- |
| Snag | -- | 13.10 | -- | -- | -- | -- | -- |

Discussion

Bird surveys and habitat assessment work were initiated at Pipestone National Monument, Minnesota in 2009, to assist the park in assessing the ecological integrity of habitat on the monument through time. Thirty-six of the 40 bird species are permanent or summer residents to the area (Stokes and Stokes 1996). Therefore, these 36 birds have some value in characterizing the breeding bird communities of PIPE. With eight of the 36 breeding species grassland obligates, it can be reasonably assumed that the ecological integrity of the grassland habitat on the monument is quite good. Current efforts to restore and maintain the grasslands at PIPE should provide a diversity of habitats necessary to support the four species of continental importance observed in the survey.

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Appendix

Appendix 1. Waypoints for Pipestone National Monument, Minnesota – UTM Zone 14 North, Datum 1983 (Conus).

| Plot I.D. | X Coordinate (Easting) | Y Coordinate (Northing) | Inventory I.D. Number |
|--------------|------------------------|-------------------------|-----------------------|
| PIPETweety1 | 714523.683 | 4877379.195 | PIPE_1 |
| PIPETweety2 | 714665.105 | 4877379.195 | PIPE_2 |
| PIPETweety3 | 714311.551 | 4877308.484 | PIPE_3 |
| PIPETweety4 | 714452.973 | 4877308.484 | PIPE_4 |
| PIPETweety5 | 714594.394 | 4877308.484 | PIPE_5 |
| PIPETweety6 | 714735.815 | 4877308.484 | PIPE_6 |
| PIPETweety7 | 714382.262 | 4877237.774 | PIPE_7 |
| PIPETweety8 | 714523.683 | 4877237.774 | PIPE_8 |
| PIPETweety9 | 714665.105 | 4877237.774 | PIPE_9 |
| PIPETweety10 | 714028.708 | 4877167.063 | PIPE_10 |
| PIPETweety11 | 714170.130 | 4877167.063 | PIPE_11 |
| PIPETweety12 | 714311.551 | 4877167.063 | PIPE_12 |
| PIPETweety13 | 714452.973 | 4877167.063 | PIPE_13 |
| PIPETweety14 | 714594.394 | 4877167.063 | PIPE_14 |
| PIPETweety15 | 714735.815 | 4877167.063 | PIPE_15 |
| PIPETweety16 | 713957.998 | 4877096.352 | PIPE_16 |
| PIPETweety17 | 714099.419 | 4877096.352 | PIPE_17 |
| PIPETweety18 | 714240.841 | 4877096.352 | PIPE_18 |
| PIPETweety19 | 714382.262 | 4877096.352 | PIPE_19 |
| PIPETweety20 | 714523.683 | 4877096.352 | PIPE_20 |
| PIPETweety21 | 714665.105 | 4877096.352 | PIPE_21 |
| PIPETweety22 | 714806.526 | 4877096.352 | PIPE_22 |
| PIPETweety23 | 714028.708 | 4877025.642 | PIPE_23 |
| PIPETweety24 | 714170.130 | 4877025.642 | PIPE_24 |
| PIPETweety25 | 714311.551 | 4877025.642 | PIPE_25 |
| PIPETweety26 | 714452.973 | 4877025.642 | PIPE_26 |
| PIPETweety27 | 714594.394 | 4877025.642 | PIPE_27 |
| PIPETweety28 | 714735.815 | 4877025.642 | PIPE_28 |
| PIPETweety29 | 714877.237 | 4877025.642 | PIPE_29 |
| PIPETweety30 | 713957.998 | 4876954.931 | PIPE_30 |
| PIPETweety31 | 714099.419 | 4876954.931 | PIPE_31 |
| PIPETweety32 | 714240.841 | 4876954.931 | PIPE_32 |
| PIPETweety33 | 714382.262 | 4876954.931 | PIPE_33 |
| PIPETweety34 | 714665.105 | 4876954.931 | PIPE_34 |
| PIPETweety35 | 714806.526 | 4876954.931 | PIPE_35 |
| PIPETweety36 | 714028.708 | 4876884.220 | PIPE_36 |
| PIPETweety37 | 714170.130 | 4876884.220 | PIPE_37 |
| PIPETweety38 | 714311.551 | 4876884.220 | PIPE_38 |
| PIPETweety39 | 714594.394 | 4876884.220 | PIPE_39 |
| PIPETweety40 | 714735.815 | 4876884.220 | PIPE_40 |
| PIPETweety41 | 714877.237 | 4876884.220 | PIPE_41 |
| PIPETweety42 | 714099.419 | 4876813.510 | PIPE_42 |
| PIPETweety43 | 714240.841 | 4876813.510 | PIPE_43 |
| PIPETweety44 | 714523.683 | 4876813.510 | PIPE_44 |
| PIPETweety45 | 714806.526 | 4876813.510 | PIPE_45 |
| PIPETweety46 | 714947.947 | 4876813.510 | PIPE_46 |
| PIPETweety47 | 714028.708 | 4876742.799 | PIPE_47 |
| PIPETweety48 | 714170.130 | 4876742.799 | PIPE_48 |
| PIPETweety49 | 714452.973 | 4876742.799 | PIPE_49 |

Appendix 1. Waypoints for Pipestone National Monument, Minnesota – UTM Zone 14 North, Datum 1983 (Conus) (continued).

| Plot I.D. | X Coordinate (Easting) | Y Coordinate (Northing) | Inventory I.D. Number |
|--------------|------------------------|-------------------------|-----------------------|
| PIPETweety50 | 714877.237 | 4876742.799 | PIPE_50 |
| PIPETweety51 | 714099.419 | 4876672.088 | PIPE_51 |
| PIPETweety52 | 714240.841 | 4876672.088 | PIPE_52 |
| PIPETweety53 | 714382.262 | 4876672.088 | PIPE_53 |
| PIPETweety54 | 714947.947 | 4876672.088 | PIPE_54 |
| PIPETweety55 | 714028.708 | 4876601.378 | PIPE_55 |
| PIPETweety56 | 714170.130 | 4876601.378 | PIPE_56 |
| PIPETweety57 | 714311.551 | 4876601.378 | PIPE_57 |
| PIPETweety58 | 714452.973 | 4876601.378 | PIPE_58 |
| PIPETweety59 | 714877.237 | 4876601.378 | PIPE_59 |
| PIPETweety60 | 714099.419 | 4876530.667 | PIPE_60 |
| PIPETweety61 | 714240.841 | 4876530.667 | PIPE_61 |
| PIPETweety62 | 714382.262 | 4876530.667 | PIPE_62 |
| PIPETweety63 | 714947.947 | 4876530.667 | PIPE_63 |
| PIPETweety64 | 714028.708 | 4876459.956 | PIPE_64 |
| PIPETweety65 | 714170.130 | 4876459.956 | PIPE_65 |
| PIPETweety66 | 714877.237 | 4876459.956 | PIPE_66 |
| PIPETweety67 | 714099.419 | 4876389.245 | PIPE_67 |
| PIPETweety68 | 714240.841 | 4876389.245 | PIPE_68 |